

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

NUTRIENT MANAGEMENT

(Acre)

CODE 590

DEFINITION

Managing the amount, source, placement, form, and timing of the application of nutrients and soil amendments.

PURPOSES

This practice may be applied as part of a conservation management system to support one or more of the following purposes:

- ◆ to budget and supply nutrients for plant production;
- ◆ to properly use manure or organic by-products as a plant nutrient source;
- ◆ to minimize agricultural non-point source pollution of surface and groundwater resources, or;
- ◆ to maintain or improve the physical, chemical, and biological condition of soil.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all lands where plant nutrients and soil amendments are applied.

CRITERIA

General Criteria Applicable to All Purposes

Plans for nutrient management shall comply with all applicable Federal, state, and local laws and regulations.

Plans for nutrient management shall be developed in accordance with: policy requirements of the NRCS General Manual (GM) Title 450, Part 401.03 (Technical Guides, Policy and Responsibilities); GM Title 190, Part 402 (Ecological Sciences, Nutrient Management Policy); technical requirements of the NRCS Field Office Technical Guide (FOTG); procedures contained in the National Planning Procedures Handbook (NPPH); and the NRCS National Agronomy Manual (NAM) Section 503.

Persons who review or approve plans for nutrient management shall be certified through any certification program acceptable to NRCS within the state.

Plans for nutrient management that are elements of a more comprehensive conservation plan shall recognize other requirements of the conservation plan and be compatible with its other requirements.

A nutrient budget for nitrogen, phosphorus, and potassium shall be developed that considers all potential sources of nutrients including, but not limited to, animal manure and organic by-products, waste water, commercial fertilizer, crop residues, legume credits, and irrigation water.

Realistic yield goals shall be established based on soil productivity information, historical yield data, climatic conditions, level of management and/or local research on similar soil, cropping systems, and soil and manure/organic by-products tests. For new crops or varieties, industry yield recommendations may be used until documented yield information is available.

Plans for nutrient management shall specify the form, source, amount, timing, and method of application of nutrients on each field to achieve realistic production goals while minimizing nitrogen and/or phosphorus movement to surface and/or groundwater.

Erosion, runoff, and water management controls shall be installed, as needed, on fields that receive nutrients.

Soil Sampling and Laboratory Analysis (Testing)

Nutrient management planning shall be based on current soil test results developed in accordance with Colorado State University (CSU) guidance or industry practice if recognized by CSU. Current soil tests are those that are no older than five years.

Soil samples shall be collected and prepared according to CSU guidance or standard industry practice. Soil test analyses shall be performed by laboratories that are accepted in one or more of the following programs:

- ◆ State Certified Programs;
- ◆ The North American Proficiency Testing Program (Soil Science Society of America), or;
- ◆ Laboratories whose tests are accepted by CSU.

Soil testing shall include analysis for any nutrients for which specific information is needed to develop the nutrient management plan. For example, analyses pertinent to monitoring or amending the annual nutrient budget should include pH, electrical conductivity, soil organic matter, nitrogen, phosphorus, and potassium.

Plant Tissue Testing

Tissue sampling and testing, where used, shall be done in accordance with CSU standards or recommendations.

Nutrient Application Rates

Soil amendments shall be applied, as needed, to adjust soil pH to the specific range of the crop for optimum availability and utilization of nutrients.

Recommended nutrient application rates shall be based on CSU recommendations (and/or industry practice when recognized by CSU) which consider current soil test results, realistic yield goals, and management capabilities. If CSU does not provide specific recommendations, application rates shall be based on realistic yield goals and associated plant nutrient uptake requirements.

The planned rates of nutrient application, as documented in the nutrient budget, shall be determined based on the following guidance.

- ◆ **Nitrogen Application** - Planned nitrogen application rates shall match the recommended rates as closely as possible, except when manure or other organic by-products are a source of nutrients. When manure and other organic by-products are a source of nutrients, see "Additional Criteria" below.
- ◆ **Phosphorus Application** - Planned phosphorus application rates shall match the recommended rates as closely as possible, except when manure or other organic by-products are a source of nutrients. When manure and other organic by-products are a source of nutrients, see "Additional Criteria" below.
- ◆ **Potassium Application** - Excess potassium shall not be applied when it can cause unacceptable nutrient imbalances in crops or forages.
- ◆ **Other Plant Nutrients** - The planned rates of application of other nutrients shall be consistent with CSU guidance or industry practice if recognized by CSU.
- ◆ **Starter Fertilizers** - Starter fertilizers containing nitrogen, phosphorus, and potassium may be applied in accordance CSU recommendations or industry practice if recognized by CSU. When starter fertilizers are used, they shall be included in the nutrient budget.

Nutrient Application Timing

Timing of nutrient applications shall correspond as closely as possible with plant nutrient uptake characteristics, while considering cropping system limitations, weather and climatic conditions, and field accessibility.

Nutrient Application Methods

Nutrients shall not be applied to frozen, snow-covered, or saturated soil, if the potential risk for runoff exists.

Nutrient applications associated with irrigation systems shall be made in accordance with the requirements of the Irrigation Water Management Conservation Practice Standard (Code 449).

Additional Criteria Applicable to Manure or Organic By-Products Applied as a Plant Nutrient Source

Nutrient content of manure and organic by-products (excluding sewage sludge or biosolids) shall be determined prior to land application based on: laboratory analysis; acceptable "book values" recognized by the NRCS and/or CSU; or historic records for the operation if they accurately estimate the nutrient content of the material. Example book values recognized by NRCS may be found in the USDA Agricultural Waste Management Field Handbook, Chapter 4 - Agricultural Waste Characteristics, or in the CSU Cooperative Extension Service Bulletin 568A, Best Management Practices for Manure Utilization, 1999.

For sewage sludge or biosolids applications, refer to the Colorado Department of Public Health and Environment, Biosolids Regulation, Regulation No. 64, 1994, as amended.

Nutrient Application Rates

The application rate (in/hr) for nutrients applied with irrigation water shall not exceed the soil intake/infiltration rate. The total application shall not exceed the field capacity of the soil.

The planned rates of nitrogen and phosphorus application recorded in the plan shall be determined based on the following guidance.

Nitrogen Application - When planned manure or organic by-product application rates are based on crop phosphorus requirements, an additional inorganic nitrogen application may be required to supply the recommended amount of nitrogen.

Manure or other organic by-products may be applied on legumes at rates equal to the estimated removal of nitrogen in harvested plant biomass.

Phosphorus Application - When manure or other organic by-products are to be applied, the planned rates of phosphorus application shall be consistent with any one of the following options:

Colorado Phosphorus Index Risk

Assessment - Nitrogen-based manure application rates for Low or Medium Risk fields, phosphorus-based application rates for High Risk fields, and no manure applications for Very High Risk fields. **

Soil Test Phosphorus - Nitrogen-based manure application rates for fields where there is a soil test recommendation to apply phosphorus. Phosphorus-based application rates or no manure application for fields where there is no soil test recommendation to apply phosphorus. **

** Acceptable phosphorus-based manure application rates shall be determined by soil test recommendations or estimated phosphorus removal in harvested plant biomass. Refer to the USDA Agricultural Waste Management Field Handbook, Chapter 6 – Role of Plants in Waste Management; or the CSU Cooperative Extension Service Bulletin 568A, Best Management Practices for Manure Utilization, 1999, or the Colorado Agronomy Technical Note 78, for guidance to develop acceptable application rates.

A single application of phosphorus, applied as manure, may be made at a rate equal to the recommended phosphorus application or estimated phosphorus removal in harvested plant biomass, for the crop rotation or multiple years in the crop sequence. When such applications are made, the application rate shall:

- ◆ not exceed the recommended nitrogen application rate during the year of application, or;
- ◆ not exceed the estimated nitrogen removal in harvested plant biomass during the year of application when there is no recommended nitrogen application, and;

- ◆ not be made on fields considered vulnerable to off-site phosphorus transport unless appropriate conservation practices, best management practices, or management activities are used to decrease the vulnerability.

Field Risk Assessment

When animal manures or other organic by-products are applied, a field specific assessment of the potential for phosphorus transport from the field shall be completed. This assessment shall be done using the Colorado Phosphorus Index Risk Assessment or other recognized assessment tools. In such cases plans shall include:

- ◆ a record of the assessment rating for each field or sub-field, and;
- ◆ information about conservation practices and management activities that can decrease the potential for phosphorus movement from the field.

When such assessments are made the results of the assessment and recommendations shall be discussed with the producer during the development of the plan.

Heavy Metals Monitoring

When sewage sludge or Biosolids are applied, the accumulation of potential pollutants including arsenic, cadmium, copper, lead, mercury, selenium, and zinc shall be monitored in accordance with the US Code Reference 40 CFR, Parts 403 and 503, and the Colorado Department of Public Health and Environment, Biosolids Regulation, Regulation No. 64, 1994, as amended.

Additional Criteria to Minimize Agricultural Non-point Source Pollution of Surface and Groundwater Resources

In areas with an identified or designated nutrient related water quality impairment, an assessment shall be completed of the potential for nitrogen and/or phosphorus transport from the field. The Leaching Index and/or the Colorado Phosphorus Index Risk Assessment, or other recognized assessment tools may be used to make these assessments. The results of these assessments and recommendations shall be discussed with the producer and included in the plan.

Plans developed to minimize agricultural non-point source pollution of surface or groundwater resources shall include practices and/or management activities that can decrease the risk of nitrogen or phosphorus movement from the field.

Additional Criteria to Improve the Physical, Chemical, and Biological Condition of the Soil

Nutrients shall be applied in such a manner as not to degrade the soil's structure, chemical properties or biological condition. Use of nutrient sources with high salt content will be minimized unless provisions are made to leach salts below the crop root zone.

Nutrients shall not be applied to flooded or saturated soils when the potential for soil compaction and creation of ruts is high.

CONSIDERATIONS

Consider induced deficiencies of nutrients due to excessive levels of other nutrients.

Consider applying additional conservation practices such as: Conservation Cover (327), Grassed Waterway (412), Contour Buffer Strips (332), Filter Strips (393), Irrigation Water Management (449), Riparian Forest Buffer (391A), Conservation Crop Rotation (328), Cover and Green Manure Crops (340), and Residue Management (329A, 329B, 329C, and 344) to improve soil nutrient and water storage, infiltration, aeration, tilth, diversity of soil organisms, and to protect or improve water quality.

Consider cover crops whenever possible to use and recycle residual nitrogen.

Consider application methods and timing that decrease the risk of nutrients being transported to surface and groundwater or into the atmosphere. Suggestions include:

- ◆ split nitrogen applications to provide nutrients at the times of maximum crop utilization;
- ◆ avoiding winter nutrient applications for spring seeded crops;
- ◆ band applications of phosphorus near the seed row;
- ◆ applying nutrient materials uniformly to application areas or as prescribed by precision agricultural techniques;

- ◆ immediate incorporation of land applied manures or organic by-products, and;
- ◆ delaying field application of animal manures or other organic by-products if precipitation capable of producing runoff and erosion is forecast within 24 hours of the time of the planned application.

Consider minimum application setback distances from environmentally sensitive areas, such as sinkholes, wells, gullies, ditches, surface inlets, or rapidly permeable soil areas.

Consider the potential problems from odors associated with the land application of animal manures, especially when applied near to or upwind of residences.

Consider nitrogen volatilization losses associated with the land application of animal manures. Volatilization losses can become significant if manure is not immediately incorporated into the soil after application.

Consider the potential to affect National Register listed or eligible cultural resources.

Consider using soil test information no older than one year when developing new plans, particularly if animal manures are to be a nutrient source.

Consider annual reviews to determine if changes in the nutrient budget are desirable (or needed) for the next planned crop.

On sites on which there are special environmental concerns, consider other sampling techniques. (For example: Soil profile sampling for nitrogen, Pre-Sidedress Nitrogen Test, Pre-Plant Soil Nitrate Test, or soil surface sampling to monitor phosphorus accumulation or pH changes.)

Consider ways to modify the chemistry of animal manure, including modification of the animal's diet, to decrease the manure nutrient content.

PLANS AND SPECIFICATIONS

Plans and specifications shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose(s).

The following components shall be included in the nutrient management plan:

1. aerial photograph or map and a soil map of the site;
2. current and/or planned plant production sequence or crop rotation;
3. results of soil, plant, water, manure, or organic by-product sample analyses;
4. realistic yield goals for the crops in the rotation;
5. quantification of all nutrient sources;
6. recommended nutrient rates, timing, form, and method of application and incorporation;
7. location of designated sensitive areas or resources and associated nutrient management restrictions;
8. guidance for implementation, operation, and maintenance, and;
9. a complete nutrient budget for nitrogen, phosphorus, and potassium for the rotation or crop sequence.

If increases in soil phosphorus levels are expected, plans shall document:

- ◆ the soil phosphorus levels at which it may be desirable to convert to phosphorus-based application rates;
- ◆ the relationship between soil phosphorus levels and potential for phosphorus transport from the field, and;
- ◆ the potential for soil phosphorus drawdown from the production and harvesting of crops.

When applicable, plans shall include other practices or management activities as determined by specific regulation, program requirements, or producer goals.

In addition to the requirements described above, plans for nutrient management shall also include:

- ◆ discussion about the relationship between nitrogen and phosphorus transport and water quality impairment; (The discussion about nitrogen should include information about nitrogen leaching into shallow groundwater and potential health impacts. The discussion about phosphorus should include information about phosphorus accumulation in the soil, the increased potential for phosphorus transport in soluble form, and the types of water quality impairment that could result from phosphorus movement into surface water bodies.)
- ◆ discussion about how the plan is intended to prevent the nutrients (nitrogen and phosphorus) supplied for production purposes from contributing to water quality impairment, and;
- ◆ a statement that the plan was developed based on the requirements of the current standard and any applicable Federal, state, or local regulations or policies; and that changes in any of these requirements may necessitate a revision of the plan.

OPERATION AND MAINTENANCE

The owner/client is responsible for safe operation and maintenance of this practice including all equipment. Operation and maintenance addresses the following:

- ◆ periodic plan review to determine if adjustments or modifications to the plan are needed; (As a minimum, plans will be reviewed and revised with each soil test cycle.)
- ◆ protection of fertilizer and organic by-product storage facilities from weather and accidental leakage or spillage;
- ◆ calibration of application equipment to ensure uniform distribution of material at planned rates;
- ◆ documentation of the actual rate at which nutrients were applied and; (When the actual rates used differ from or exceed the recommended and planned rates, records will indicate the reasons for the differences.)
- ◆ records maintenance to document plan implementation.

As applicable, records shall include:

- ◆ soil test results and recommendations for nutrient applications;
- ◆ quantities, analyses and sources of nutrients applied;
- ◆ dates and methods of nutrient applications;
- ◆ crops planted, planting and harvest dates, yields, and crop residues removed;
- ◆ results of water, plant, and organic by-product analyses and;
- ◆ dates of review and person performing the review, and recommendations that resulted from the review.

Records should be maintained for five years, or for a period equal to the full implementation period of the plan if longer than five years, or for a period longer than five years if required by other Federal, state, or local ordinances.

Workers should be protected from and avoid unnecessary contact with inorganic fertilizers, manures, and organic by-products. Protection should include the use of protective clothing when working with plant nutrients. Extra caution must be taken when handling ammonia sources of nutrients, or when dealing with organic wastes stored in unventilated enclosures.

The disposal of material generated by the cleaning of nutrient application equipment should be accomplished properly. Excess material should be collected and stored or field applied in an appropriate manner. Excess material should not be applied on areas of high potential risk for runoff and leaching.

The disposal or recycling of nutrient containers should be done according to state and local guidelines or regulations.

REFERENCES

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Colorado Agronomy Technical Note No. 77, Pesticide and fertilizer application, operation, safety, and maintenance, 1991, Natural Resources Conservation Service, USDA, Lakewood, CO.

Colorado Agronomy Technical Note No. 78, Nutrient management planning guidelines, 2000, Natural Resources Conservation Service, USDA, Lakewood, CO.

Colorado Agronomy Technical Note No. 92, Manure spreader calibration, 2000, Natural Resources Conservation Service, USDA, Lakewood, CO.

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Colorado Agronomy Technical Note No. 95, Colorado phosphorus index risk assessment, 2000, Natural Resources Conservation Service, USDA, Lakewood, CO.

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- ◆ No. XCM-175, Best Management Practices for Phosphorus Fertilization, 1994.
- ◆ No. XCM-178, Best Management Practices for Pesticide and Fertilizer Storage and Handling, 1994.
- ◆ No. 568A, Best Management Practices for Manure Utilization, 1999.
- ◆ No. 0.500, Soil Sampling, 2000.
- ◆ No. 0.501, Soil Testing, 1999.
- ◆ No. 0.502, Soil Test Explanation, 1999.
- ◆ No. 0.507, Soil, Water, and Plant Testing, 2000.
- ◆ No. 0.508, Fertigation Through Surge Valves, 1995.
- ◆ No. 0.509, Vegetable Fertilizer Guide 1993.
- ◆ No. 0.512*, Fertigation, 1992.
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- ◆ No. 0.520*, Selecting an Analytical Laboratory, 2000.
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- ◆ No. 0.542*, Fertilizing Sugarbeets, 1996.
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- ◆ No. 0.548*, Fertilizer Cost Calculations, 1993.
- ◆ No. 0.550*, Nitrogen Sources and Transformations, 1996.
- ◆ No. 0.553*, Fertilizer Practices and Efficiency, 1999.
- ◆ No. 0.555*, Grain Protein Content and N Needs, 1992.
- ◆ No. 0.560, Cattle Manure Application Rates, 1997.
- ◆ No. 0.561*, Manure Spreader Calibration, 1999.
- ◆ No. 0.565*, Update on Manure and Effluent Recommendations, 2000.
- ◆ No. 1.222, Liquid Manure Application to Cropland, 1998.
- ◆ No. 1.223, Liquid Manure Application Methods, 1998.

* Available in electronic format only.